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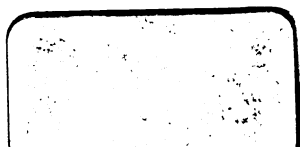
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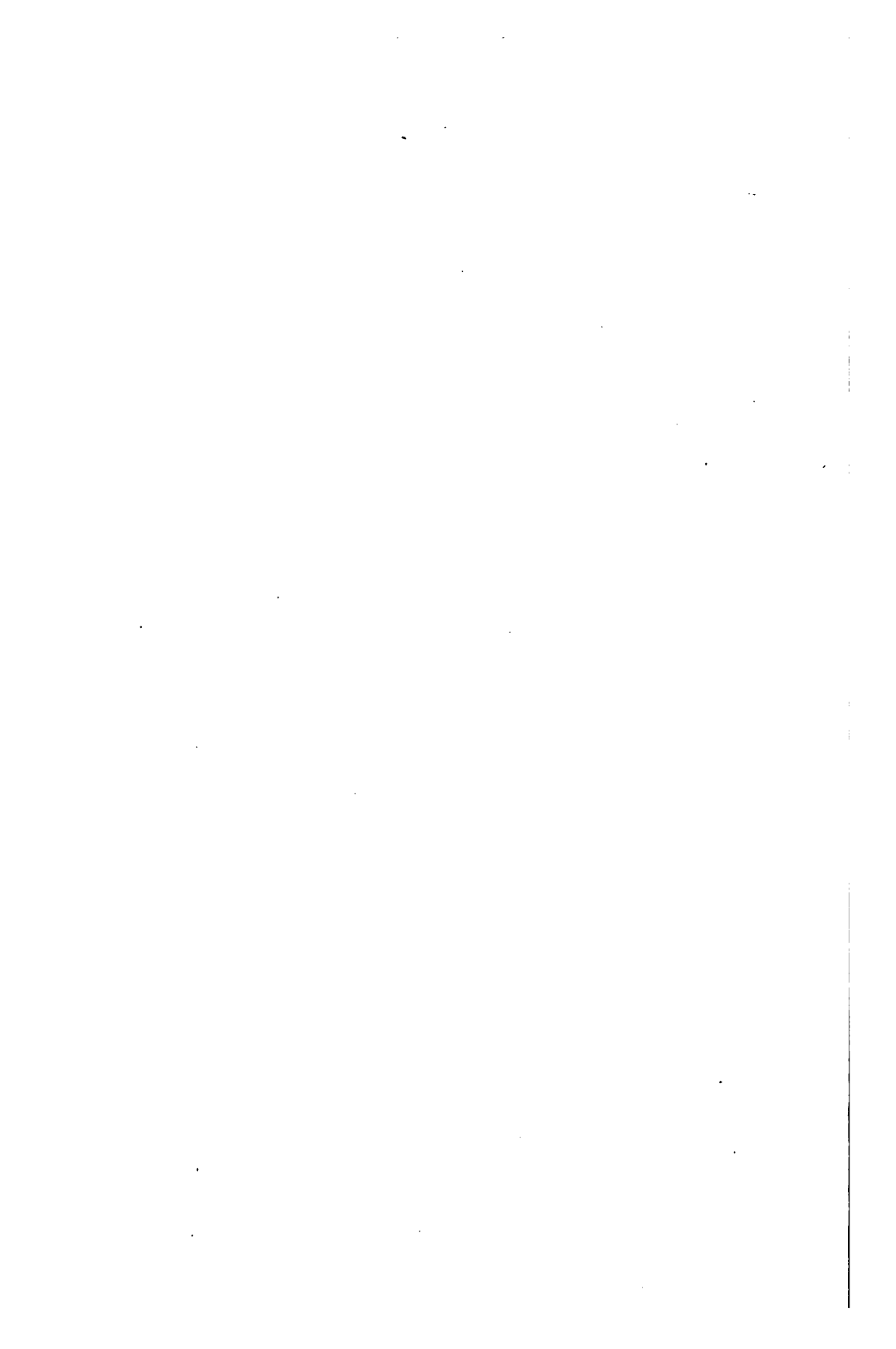
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JOHNEYER'S
FIRST LESSONS IN
ARITHMETIC
RANGE 1-100
TURNBULL



600048426U





FIRST LESSONS IN ARITHMETIC

BY MEANS OF BRICKBOX AND

SQUARE-RULED SLATE.

FOR THE USE OF ELEMENTARY-SCHOOL TEACHERS

AND FOR HOME USE.

BY

FERDINAND SCHNEYER.

WITH A PREFACE BY FR. TH. HECKENHAYN.

FIRST PART: NUMBER-RANGE 1—10.

TRANSLATED FROM THE SECOND EDITION (1879)

BY

W. P. TURNBULL,

FELLOW OF ST. CATHARINE'S COLLEGE,

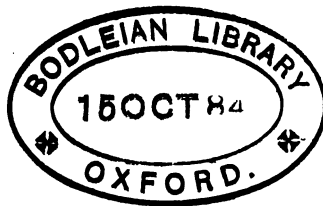
LATE FELLOW OF TRINITY COLLEGE, CAMBRIDGE.

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1884.

1802. e. 9.



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are due to Dr. Karl Dammann of Birmingham.

PREFACE.

BY FR. TH. HECKENHAYN, SCHULDIRECTOR.

THE little book which I beg to introduce to the public treats of first arithmetical instruction in the number-range 1—10. It owes its origin on the one hand to that psychological knowledge which should be at the foundation of every treatise on teaching; on the other hand to the actual practice, based on that knowledge, in our school.

Those teachers of the hardworking sort who, generally through no fault of theirs, are in the wrong way or have vainly sought for the right way will find in this book a welcome guide and an incentive to a free and independent treatment of the subject. Only the indifferent and the too proud will lay it aside unregarded.

The work is based on the often-forgotten Brickbox of Tillich, and for this reason, that the Brickbox of Tillich fulfils, as no other apparatus for aiding arithmetical teaching fulfils, all the conditions laid down as the result of psychological reflection on teaching. We hold it, accordingly, to be the relatively completest apparatus, and we must needs recognize something utterly injurious in the shallow talk which is often resorted to by way of illustration, about fingers, beans, windows, apples, nuts and so on. For it is only in very rare cases that these means are forthcoming as visible things, and moreover, in their usual crude and motley application, they are not capable of forming and fixing ideas of numbers in the mind.

Tillich's Brickbox, which is described in detail in this little work, is intended in the first instance to provide for the *forming* of number-ideas. As number in itself is some-

thing unknown until it is embodied in things, it follows that number-ideas first take form from counted things. They arise of themselves through looking at things, but that way is a long one. Instruction cannot go the whole length of that way, and therefore uses artificial means which lead to the same end. The forming of number-ideas will go on the faster if one uniform means be constantly applied, so that all disturbance is avoided which would be caused by forming ideas of other things. For instance, if I create the idea of 6 by the child's frequent beholding of the brick 6, that idea will be much firmer than if in one and the same lesson there is talk in motley variety about 6 beans, 6 apples, 6 nuts, 6 pennies and so forth, things which the child has not even a sight of. Only after the number-idea has been already formed by *one* apparatus, is it reproduced, and at the same time more firmly fixed, when other things come into view.

In *fixing* number-ideas, too, the goal must needs be more quickly reached with artificial aid than without. That fixing, when the idea of the number has been once gained, comes about through viewing the number from all sides, by comparing with other numbers, by measuring and dissecting. Tillich's Brickbox offers, in respect of these operations, the advantage of always coming back to the act of beholding and to the presentation of the number as a visible magnitude. Therein consists its immense superiority. A number can *actually* be measured by another number, can *actually* be dissected into two or more numbers. It can *actually* be made visible that 8 consists of 4 twos or 2 fours, that it is less than 10 by 2, and greater than 5 by 3, because each number appears as a magnitude, and accordingly is imaged by the child as such. And by this continual return to the act of beholding the idea is fixed firm.

The next higher step consists in this, that the number-idea unfixes itself from the auxiliary apparatus. Quickness in reckoning, that is, quick and accurate working with numbers, is the surest proof that the teaching has in the right way provided for the forming and fixing of number-ideas. It always was a great pleasure to me to see how

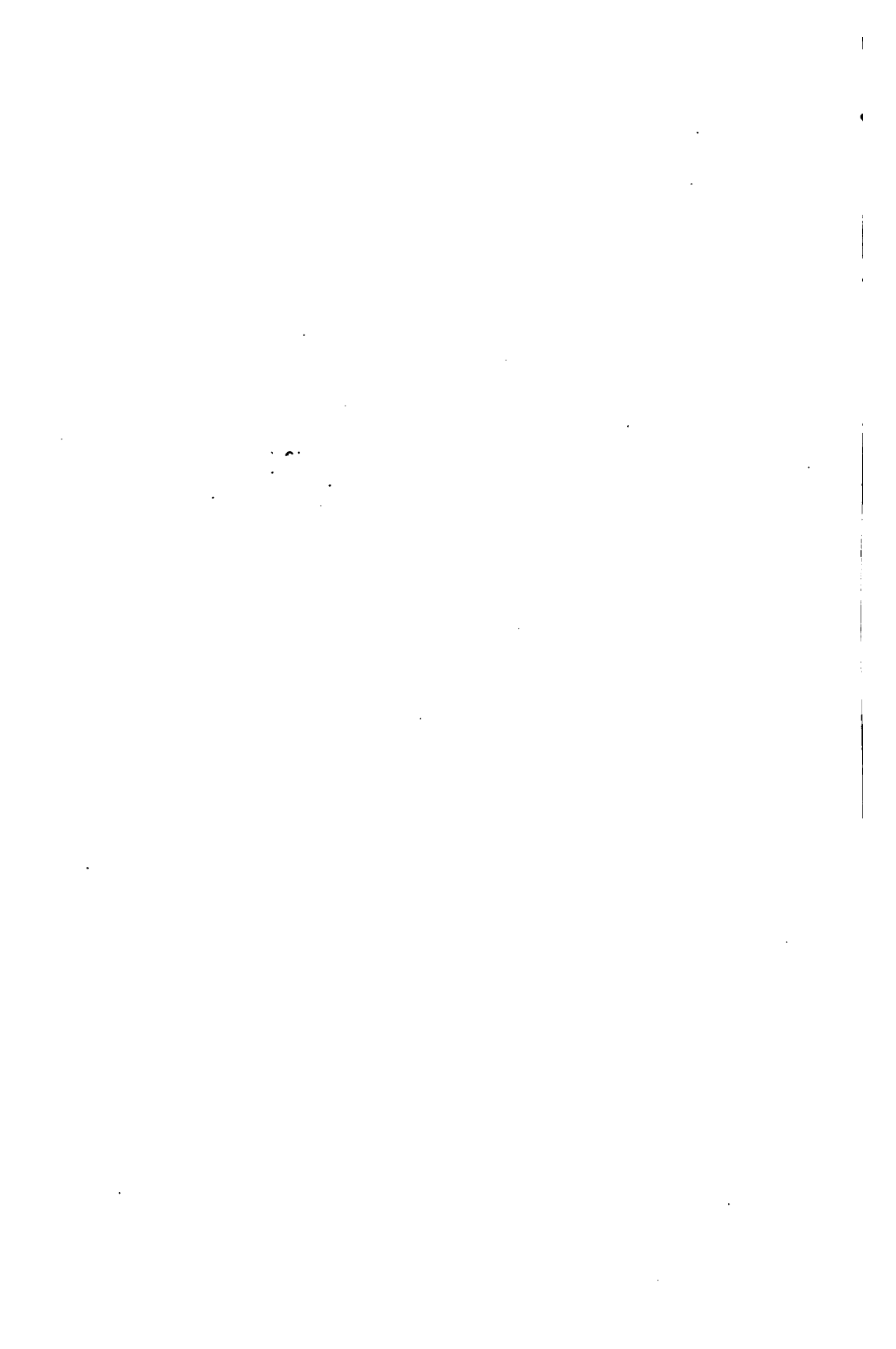
our little children in the first school-year felt themselves quite at home in the number-range 1—10, and carried out even the longest processes with ever fresh zeal. For the teaching had awakened interest, as teaching always does where it claims the child's whole mental activity.

The chief help to sustaining interest should be found in applying the brickbox to building and drawing. In this way a preparation should be getting made for future instruction in drawing. Teachers who have a sympathy with children's occupations will hail as a welcome extra advantage this application of the box.

May, then, this little book in its modest degree contribute its share to "Making word and sound weightless in the ideas of men, and giving, in instruction, to the act of beholding all that preponderance which it so manifestly ought to have over word and sound."

COBURG,

27 March, 1871.



PREFACE TO THE SECOND EDITION.

SINCE the appearance of this little book, Tillich's Brickbox, on which the book is founded, has enjoyed an increasing circulation. It has been introduced in many schools, as for instance in Meiningen and Weimar, and compulsorily in all the schools of the Grand Duchy of Coburg. This increasing circulation is shown also by several First arithmetic treatises, based on the same principles as this book which have appeared since its first publication. That which, now more than eight years ago, caused the first publication of this book, imprinted also on the book its peculiar character. Experience showed that a bare statement of the principles of this method of teaching, for those who had themselves been taught on other principles, was often insufficient to enable them to give the instruction successfully, and only led to such a confusion of diverse principles as could not but be hurtful to the teaching. Moreover, the successful co-operation of the Home, in the case of children with specially weak arithmetical ability, was only possible when a fully detailed account of the method could be presented.

That the little book has, in respect of this purpose, done good, is shown by the grateful communications which the Author has received from the most various quarters and until quite recently. These have strengthened him in the conviction that, wherever the way here traced out has been entered on and faithfully and consistently followed, the results, not only as to gaining a sure foundation for arithmetic but also as to creating and maintaining in the little

scholars the most delighted readiness to learn, are quite surprising. The Author sends this second edition, almost unaltered, to school and home, because the little work has originated, not in a miserable love of bookmaking, but in a conviction, founded on the experience of many years, that with the spread of Tillich's Brickbox a real service is done to the young.

F. SCHNEYER,
Seminarlehrer.

COBURG,
May, 1879.

INTRODUCTION.

[Let the reader imagine a class of children who, having completed their sixth year or being within a few months of completing it, are now beginning their school-life.—Tr.]

THAT teacher who starts with a right feeling for the little troop introduced to him, will take this for his main principle, not forthwith to spoil and suppress, but to preserve and win over to help him in his work, the gaiety and playfulness so characteristic of healthy children at the age I am supposing ; in other words, to lead his scholars in an easy natural way from the playroom to the school.

He will only succeed in this endeavour by knowing how to interest the little folk, how to make the strange place they are in, with all its new belongings, so homelike to them that presently, when at their own homes, they shall be all impatience for school to begin again.

How then is the first arithmetical teaching to be shaped, if it is to obey this main principle and at the same time be fruitful in result ?

Plainly the task to be accomplished by this teaching is to store the scholar's mind with a certain material for thought to work with freely and to make this material the scholar's sure possession. This material, indeed (counting, dissection of numbers, the multiplication table &c.), is the foundation whereon all later teaching is based, and without which we could not work the simplest sum. But, in proportion as such material has been gained on psychologically right principles—through the scholar's actually looking at

things with his own eyes—and made the scholar's second nature by diligent practice, the more securely and speedily will it be ready for thought to work with. But how can this task, seemingly so dry, be made suitable for gay, playful children in their sixth year? People have asked that question, and have tried to reconcile the supposed contradiction by making arithmetic into sugar-plums—"Examples from Child-life"—and talking about "rosy apples," "golden nuts," "pretty eggs," and so forth. Thereby it became evident, not only that the teacher most rich in fancy soon got to the end of these illustrations, while a superfluity of words crowded out true arithmetical practice, but also that the child's mental representing power fixed itself rather on the *object* than on the *number*, and so the teaching missed its essential aim, which was to form mental representations of numbers.

Thus it not seldom happened to me that a child, after it had, with a great deal of trouble, learned to see that 3 strokes and 1 stroke were 4 strokes, yet, for that very reason, could give no answer to the next question, "How many apples are 3 apples and 1 apple?"¹

Other persons appear to have had similar experiences. At any rate, the declaration in the preface to A. Heine's excellent Arithmetic may well be supposed to point in this direction:—"It would certainly be better if the teaching of arithmetic did not begin with the beginning of school-teaching but, say, with the Middle² class; but things

¹ "How hard it is for a child, with concrete things before him to look at, to suppress the *material* interest and rise to the grasping of abstractions, is shown by the great difficulty which quite little children have to contend with in order to rise to the comprehension of number. You show the child three nuts, three fingers, three coins, to lead him to comprehend the number 3, and you find yourself deceived in your expectations, for the child *has* truly apprehended the nuts, the fingers, the coins, but not that abstraction which is expressed by the number three."—DR. G. A. LINDNER, *The A B C of Beholding (Anschauung). Year-Book of the Society for Scientific Teaching*, 1871.

² According to a note with which I have been favoured, Wurst, "once a great authority on the organization of *elementary* schools,"

are as they are, and we teachers must accommodate ourselves to them." As a set-off against such experiences, I must joyfully bear witness that in my case arithmetic, with the *Brickbox* for a means of making number visible—the arithmetic which I learned some four years ago through Herr Bräutigam (now Seminary-Teacher in Bielitz)—soon became the favourite subject of instruction, ever bringing life and *universal interest* into the little troop of scholars and followed by the most beautiful results.

Here, too, I verified the old experience, that grown-up people are often mistaken as to what they think ought to be interesting or wearisome to the young,¹ and that children are ever attracted by that which is suited to their power of comprehension, and which, making them self-active in various directions, really advances them.

I did not omit to draw the attention of my colleagues to this use of the *Brickbox*, and I had the pleasure of seeing how they all had the same experience, if they only completely broke with their previous wont. Further, I caused the *Brickbox*, in the case of weak children, to be brought into use in a prescribed manner at home, and I saw results which—I know it by an experience of many years—could never have been attained in any other way. These circumstances have induced me to make known to wider circles the way in which I apply the *Brickbox* and *Square-ruled Slate* to first instruction in arithmetic, and perhaps to give one more relief to many a teacher and one more delight to many a child.

The *Brickbox* here referred to consists of bricks which have the *cube* as the element of their form. The cube (edge, for schools, of about $1\frac{1}{2}$ inches, for home use and private teaching proportionally smaller), represents *one*. divides a school of, say, 120 children (ages 6 to 14) into three classes, each with two divisions. Children from 7 to 8 and some (slow) from 8 to 9 are in the higher division of Class I. Children from 8 to 9 and 9 to 10 are in the lower division of Class II. (the Middle class).—[Tr.]

¹ How silly and flavourless, for example, many children's verses and games are to us, which yet to the little ones themselves give the most unmistakeable pleasure.

Two cubes in one piece, separated simply by a black line, represent *two*, and so on, up to *ten*. In the brickbox *one* occurs 20 times; *two*, 10 times; *three*, 8 times; *four* and *five* each 4 times; *six*, *seven*, *eight*, *nine* and *ten*, each twice.

"Good" often finds a foe in "Better." Thus Tillich's original brickbox, in which *each* number-brick occurs 10 times, has, in the above scheme, been somewhat lessened.

The bricks, if they are to be distinctly recognized by all the scholars in a large class, should not be too small. But, with the above dimensions ($1\frac{1}{4}$ inches for the cube-edge), that original brickbox would have grown too big and heavy and not handy enough, and so in many arithmetic lessons it would perhaps have stood in a corner unused. To avoid all inducement to this in the apparatus itself, the apparatus was simplified in the manner above stated.

This brickbox is not a *counting apparatus* (like the so-called Russian counting machine¹), by which the child learns to *count*, but not to *calculate*, *i.e.*, to operate with numbers mentally represented, but it is a true means of making numerical magnitudes visible. To the children its bricks *are* the numbers.

The square-ruled slate required for the children's use is an ordinary slate which has on one side the net-ruling for writing,² on the other a square-ruled network of lines. Care must be taken that the squares be not too small (22 to 24 squares to an edge of an ordinary middle-sized slate³), and that they be ruled as truly as possible.

The blackboard to be used for teaching is, like the slates, provided with squares with sides about 2 inches long or longer [5 to 6 centimetres]. If the teacher has the brickbox at hand, and the scholars' slates and pencils are in due order, the instruction can begin.

¹ A ball-frame of some kind.—[Tr.]

² We use the net-ruling for the Herzsprung-Stiller writing method. [*This* ruling for writing purposes is not essential to the teaching of arithmetic. What is needed is the *square* ruling.—Tr.]

³ Consider this slate to measure, exclusively of frame, somewhat more than $9\frac{3}{4}$ inches by somewhat more than $6\frac{1}{4}$ inches.—[Tr.]

EXERCISES.

I.

PREPARATORY INSTRUCTION.

THE first lessons, which had for their object the making teacher and scholars learn to know each other, are now over. The teacher takes his box of bricks and builds in the presence of the children on the desk (or on a table) a bridge, a cross, a tower, a castle &c. Plates III., IV. and V. give some examples of forms which can be constructed with the brickbox. The teacher also makes some of the children build. A merry life springs up in the little group; the little ones, who at first were in some degree awed by their many new impressions, will soon grow more and more confiding, and if the teacher attains nothing beyond this, that the eyes of all are fixed with the utmost attention on him and his doings—that is enough for a beginning. If the little folk grow tired, the slate will be resorted to, the manner of holding the pencil and the movement of the arm practised to the word of command, and perhaps vertical strokes, as long as the side of one of the squares, drawn on the slate's lines. (Pl. I. 1.) The teacher may call these strokes "matches," or call them by any other name current among the children.

EXERCISE 2.

Continuation of the preceding. Matches, horizontal. (Pl. I. 1.)

EXERCISE 3.

Continuation. Little boxes for the matches drawn and filled with matches. (Pl. I. 1.)

Each of these preparatory exercises requires about 1—2 half-hours.

II.

LEARNING TO KNOW THE BRICKS.

EXERCISE 4.

The teacher says to the children that now the bricks are to have *names*. He takes the cube in his hand, shows it, and says, "That is *One*." The children repeat this after him in chorus. Then the *two*, and so on to the *five*. The bricks 1—5 are set up in order (ascending, for the teacher, from right to left). The teacher points to one brick after another, and the children answer in order, standing up, *loudly*, "That is One," "That is Two." The teacher points to the bricks out of order, and gets them named by the same names. For writing-exercise lines are drawn two squares long, and called, say, slate-pencils. (Pl. I. 2.)

EXERCISE 5.

Rapid repetition of the preceding exercises. The scholars' answers must follow quicker and quicker on each other, and go through the class like a running fire without many words from the teacher. *The form of the answers must therefore be strictly adhered to.* Then the teacher puts the *six* with the bricks already in the row, and says, "That is Six." Chorus: "That is Six." Exercise from the beginning as above. For a change the teacher shuffles the six bricks, and makes a scholar rebuild the row. Writing: Stroke three squares long. By this means we make a pencil-box filled with pencils. (Pl. I. 3.)

EXERCISE 6.

Repetition. Then Seven is introduced, and all previous exercises are again gone through. The main point is that

the answers follow each other with increasing loudness and speed. Writing: the *One* and the *Two* copied. (Pl. I. 4.) For a change and further hand-practice, all the figures in Plates I., II. and V. serve that do not directly relate to reckoning.

EXERCISE 7.

Eight introduced.

Writing: Staircase of 1, 2, 3. (Pl. I. 5.)

EXERCISE 8.

Nine introduced.

Writing: Staircase of 1, 2, 3, 4. (Pl. I. 6.)

EXERCISE 9.

Ten introduced.

Writing: Staircase of 1, 2, 3, 4, 5. (Pl. I. 7.)

EXERCISE 10.

Recapitulation till the greatest readiness is attained. If the children have a difficulty in recognizing the larger bricks (6, 7, 8, 9, 10) standing alone, the next less bricks are to be placed against them, and so on, until by comparison they recognize the size required. This is, to say the least, far more beneficial than to make them find out the required names by counting one by one the cubes of which a brick consists. Still worse is it to write on the bricks, in order to facilitate the recognition of them, the *figures* relating to them, as has happened here and there.

Writing: Crosses, &c. (Pl. I. 8.)

EXERCISE 11.

Teacher. "Shut your eyes." While the children have their eyes shut, the teacher quickly takes a brick away.

"Open them! What have I taken away?" A child brings the brick back to its proper place.

This exercise and others of a like kind serve to enliven the whole work. The more inventive the teacher is at this, the more inspiring is the effect of it.

Writing: The Six drawn. Staircase &c. (Pl. II. 1.)

Exercises 4 and 5 require each half-an-hour; those which follow it require from two to three half-hours.

III.

ORDER OF THE BRICKS: COUNTING.

EXERCISE 12.

The children cease to use the formula, "That is," and say, while the teacher points: One, two, three, four &c. Then backwards: Ten, nine, eight &c.

EXERCISE 13.

The scholars now begin to give a new form of answer. They can say either "After One comes Two" &c. or "One has Two after it." *Only, the teacher must steadily keep to one form.* The first answers follow the teacher's questions, the later are given on his simply pointing to the bricks concerned.

Writing: Bricks 1—8. (Pl. II. 3.)

EXERCISE 14.

"Before Ten comes Nine." "Before Two comes One" &c. Treated as Exercise 13.

Writing: Bricks 1—9. (Pl. II. 4.)

EXERCISE 15.

Teacher. "What comes between One and Three?"
Children. "Between One and Three comes Two" &c. The

teacher must always point out the bricks referred to, and question and answer must rapidly succeed each other.

Writing : 1—10. (Pl. II. 4.)

EXERCISE 16.

The teacher makes the children count, and he always skips over a brick (or several bricks, as the case may be). The teacher points, and the scholars speak in order: 1, 3, 5, 7, 9.—10, 8, 6, 4, 2.—2, 4, 6, 8, 10.—9, 7, 5, 3, 1.—1, 4, 7, 10.—10, 7, 4, 1, &c.

Writing: The built-up row 2, 4, 6, 8, 6, 4, 2 copied. (Pl. II. 3.)

Time: Two half-hours for each of the exercises 12—16, with repetition of the preceding exercises.

IV.

COMPARING THE BRICKS.

GREATER—LESS.

EXERCISE 17.

Two boys are called out and placed together. They are to measure themselves together. They are *equal*. Two others measure themselves together, and the rest of the class find that "A is greater than B," "B is less than A." Now the One and the Two are to be measured. They are placed together. "Which is greater?"

Form of Answer:

"Two is greater than One."

"Three is greater than Two."

"Four is greater than Three."

And so on up to Ten, through the class.

Writing: 2, 4, 6, 8, 10 copied.

EXERCISE 18.

The last exercise repeated. "Which is less?" "B is less than A," "One is less than Two" &c. &c. up to 10.

Writing: 1, 4, 7, 10 copied.

EXERCISE 19.

The teacher has the bricks lying before him. He puts up two of them together, and the children form their little sentences about them *without further words from the teacher*; e.g., the teacher puts up—

2, 1.

Children. "Two is greater than One; One is less than Two."

3, 1.

"Three is greater than One; One is less than Three."

3, 2.

"Three is greater than Two; Two is less than Three."

4, 1.

"Four is greater than One; One is less than Four."

4, 2.

"Four is greater than Two; Two is less than Four."

4, 3.

"Four is greater than Three; Three is less than Four."

And so with all numbers.

Writing: 2, 5, 8 copied.

EXERCISE 20.

This exercise is a repetition of the three preceding exercises, but with a statement of the difference between the bricks compared:

(a) "Two is one greater than One" &c. up to Ten.

(b) "One is one less than Two" &c.

(c) "Four is one greater than Three" &c.

"Four is two greater than Two" &c.

"Four is three greater than One" &c.

And so all bricks are compared together. The teacher meanwhile says as little as possible and *never sets before the eyes of the scholars any bricks except those which have to be compared.*

Writing: 10, 8, 6, 4, 2 copied.

For Exercises 17, 18, 19 half-an-hour each; for Exercise 20 from 8 to 10 half-hours.

V.

DISSECTION OF THE BRICKS.

EXERCISE 21.

The teacher takes the Two and says something like this : " Now we will see *how great* Two is." He sets a One against it, and on this One he places another One. The children soon find out " Two is as great as One and One." So with Three. " Three is as great as Two and One." " Three is as great as One and Two." " Three is as great as One and One."

Writing : Figures 1 and 2. By this time the little ones are so far advanced in writing that they can copy figures. *Teacher.* " Pencils up ! Look at my hand." The teacher draws a little square on the blackboard. " What have I made a picture of ?" *Children.* " You have made a picture of One." *Teacher.* " Now I am *writing* a One inside."¹ The children draw the One and write the figure 1. Two is practised in the same way. (Pl. III. 1.) The teacher makes the children write the figures always *on* the bricks drawn, and exactly in the uppermost square of each brick, but never several figures in one brick. The figure has no value except as a name for the brick concerned.

EXERCISE 22.

Dissection of Four as above.

Writing : 1, 2, 3, 4 copied ; figures made on the bricks. (Pl. III. 1.)

EXERCISE 23.

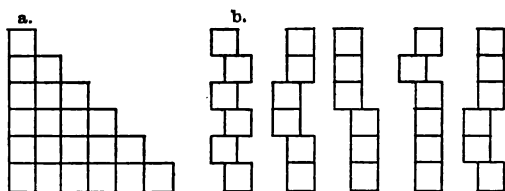
Dissection of Five.

Writing : 1, 2, 3, 4 and 5 copied ; " Figures in !"

¹ The children must continually have their eye on the teacher's hand when he is writing or drawing.

EXERCISE 24.

As the dissection of the numbers is of the greatest importance, it shall here be indicated still more in detail, with Six for example. The teacher has built



(This is how the bricks stand, seen from the children's place.)

The teacher points, after the weakest scholars have named the bricks, to the Five (Fig. a), takes away the One at the lowest end of the structure, puts it on the Five and makes the children say "Six is as great as 5 and 1." Then the 2 on the 4; and they say "Six is as great as 4 and 2." And so on, always quicker and quicker, through the class. The placing of brick upon brick will soon cease to be necessary; and so a step further has been made, in that the child for the first time is obliged to imagine a numerical magnitude without immediate means of beholding it.

In Fig. b the separate bricks of which the Six is built are placed not exactly over one another, in order to make it easier to recognize them. The teacher points to each of these, and the children say "Six is as great as One and One and One and One and One and One." "Six is as great as Two and Two and Two." To enliven matters, the teacher sets this task: "Who can build a new Six?" Individual scholars will show themselves very inventive at this, but pleasure and mental exertion will light up the faces of all.

Writing: 1—6 drawn. Figures put in.

EXERCISE 25.

Dissection of Seven just as in the case of Six.

Now the need of abbreviation makes itself felt ; perhaps it has already done so in the dissection of Six. " It's tiresome to say 'Six is as great as One and One and One and One and One and One.' Who knows how to say that shorter?" The children discover without difficulty :

" Six is as great as 6 times 1."

In like manner :

" Six is as great as 3 times 2."

" Six is as great as 2 times 3."

" Seven is as great as 3 times 2, and 1."

Herewith has the transition been made to multiplication.

Writing : 1—7 drawn, and figures.

EXERCISE 26.

Dissection of Eight. Writing : figures 1—8.

EXERCISE 27.

Dissection of Nine. Writing : figures 1—9.

EXERCISE 28.

Dissection of Ten. Writing : figures 1—10.

EXERCISE 29.

Exercises 21—28 prepare the way for the four elementary rules, and therefore are to be several times repeated and well practised into the children. In the first repetition, at the end of every lesson, the teacher makes the children, for a writing exercise, copy the sums that have been built and write figures in them. Example : Pl. III. 2a.

At * the teacher places the Six in front of the Seven and makes the children say "Six is Seven minus One," "Six is Eight minus Two" &c.

Writing : (the mark — means *minus*).

[N.B. The German word explains itself, or at least explains itself in some fashion. Its equivalent in English is "less," which perhaps it would be well to use instead of "minus."]

$$6 = 5 + 1.$$

$$6 = 6 \times 1.$$

$$6 = 8 - 2.$$

$$6 = 4 + 2.$$

$$6 = 3 \times 2.$$

$$6 = 9 - 3.$$

$$6 = 3 + 3.$$

$$6 = 2 \times 3.$$

$$6 = 10 - 4.$$

$$6 = 1 + 5.$$

$$6 = 7 - 1.$$

$$6 = 2 + 4.$$

$$6 = 3 + 2 + 1.$$

EXERCISE 32.

In dissecting numbers the individual numbers 4, 6, 8, 9, 10 may be looked at quite apart and (each) treated specially. In doing this the teacher should have an eye to many-sidedness and variety. I give for this purpose a few more examples :—

(a.) *Teacher.* "We will build 4. I put up 2. What do you do next?" *Scholar.* "I put 2 on it."

Teacher. "I put up 5." *Scholar.* "I take 1 away."

(b.) This process is soon shortened thus: The teacher names a number and the scholar gives the necessary supplementary number. *Teacher.* "4 is 1." *Scholar.* "And 3." *Teacher.*¹ "4 is 5." *Scholar.* "Minus 1." *Teacher.* "4 is 9." *Scholar.* "Minus 5," &c., &c., going through the class quicker and quicker.

Writing : The teacher writes tasks like the following on the board :—

$$4 = 1 + 3^*$$

$$4 = 3 + 1^*$$

$$4 = 5 - 1^*$$

¹ The English teacher is requested to notice that the *and* is supplied by the scholar. The teacher does not say "4 is 1 *and*—."—[Tr.]

EXERCISE 30

EXERCISE 30

In the second repetition of these exercises 21-28, must be taken to make the children by degrees give their answers, 45. "Instead of saying: 'Six is a part Five and One' it is enough to say 'Six is Five and One'." The children take very much to these abbreviations. As regards writing, with its repetition comes the translation, into the form used in written arithmetic, of the sums which have been built up in accordance with Exercise 29) copied. The teacher has built a sum (cf. Pl III. 24).

+ means 'and.'

x means 'times.'

= means 'is.'

The marks must be written, each in a square: the x is made by observing opposite corners of a square.

Example: Pl III. 24.
With pride and delight the little ones take home their first "sum in arithmetic," like those they have seen their big sisters have, and the cleverer ones are unwearied in devising new combinations.

EXERCISE 31.

In the third repetition of Exercises 21-28, these exercises are extended by introducing the minus. I will again give for an example of the way in which this can be done. The teacher builds:



EXERCISES

* the teacher places the Six in front of the Five, and says the children say "Six + Five = Eleven minus Two" &c.
 Writing: (the mark — means minus)
 [B. The German word *minus* means "less" or "minus," which perhaps it would be better to use.]

$$\begin{aligned} 6 &= 5 + 1. & 7 &= 6 + 1. \\ 6 &= 4 + 2. & 7 &= 5 + 2. \\ 6 &= 3 + 3. & 7 &= 4 + 3. \\ 6 &= 1 + 5. & 7 &= 2 + 5. \\ 6 &= 2 + 4. & 7 &= 3 + 4. \end{aligned}$$

E

In dissecting numbers, the children learn that 10 may be looked at in many different ways. In doing this the teacher should be careful to avoid sidedness and variety. In the same examples:—

(a.) Teacher: "What is 3 + 3?"
 do next?" Six + Three = Nine.
 Teacher: "What is 7 + 3?"
 (b.) This process is continued until the children names a number and supplement it with another number.
 3." Teacher: "What is 3 + 3?"
 is 9." So the children learn that 10 can be made in many different ways, and are now again, the result is just the same as above its fellow.
 out the answer, the brickbox is built.
 that have been built, generally, omitting the result to the children.

quicker and more sure, and are now again, the result is just the same as above its fellow.
 Writing: The teacher writes the result to the children.

the board—
 out the answer, the brickbox is built.
 that have been built, generally, omitting the result to the children.

EXERCISES.

EXERCISE 36.

$$\begin{array}{lll}
 1 + 1 + 1 = 3. & 1 + 2 + 3 = 6. & 1 + 5 + 1 = 7. \\
 2 + 2 + 2 = 6. & 2 + 3 + 4 = 9. & 2 + 5 + 2 = 9. \\
 3 + 3 + 3 = 9. & 3 + 4 + 3 = 10. & 3 + 5 + 1 = 9.
 \end{array}$$

Writing: Similar tasks.

EXERCISE 37.

The "minus" [less] first illustrated once more with the brickbox (Exercise 31), then the question inverted.

Groups:

$$\begin{array}{lll}
 (a) \ 4 - 1 = 3. & (b) \ 5 - 2 = 3. & (c) \ 9 - 3 = 6. \\
 7 - 1 = 6. & 10 - 2 = 8. & 7 - 3 = 4. \\
 9 - 1 = 8, \text{ \&c.} & 8 - 2 = 6, \text{ \&c.} & 6 - 3 = 3, \text{ \&c.} \\
 & 10 - 4 = 6. & \\
 & 8 - 4 = 4. & \\
 & 9 - 4 = 5, \text{ \&c.} &
 \end{array}$$

Writing: Similar tasks.

EXERCISE 38.

$$\begin{array}{lll}
 3 + 3 - 2 = 4. & 1 + 4 - 3 = 2. & 4 + 5 - 8 = 1. \\
 4 + 4 - 1 = 7. & 2 + 5 - 4 = 3. & 3 + 2 - 5 = 0. \\
 5 + 5 - 9 = 1. & 3 + 6 - 7 = 2. & 5 + 2 - 3 = 4. \\
 2 + 2 - 3 = 1. & 2 + 8 - 5 = 5. & 6 + 4 - 8 = 2. \\
 3 + 5 - 2 = 6. & 4 + 6 - 3 = 7. & 7 + 2 - 6 = 3.
 \end{array}$$

Writing: Similar tasks.

EXERCISE 39.

$$\begin{array}{lll}
 8 - 4 + 3 = 7. & 8 - 3 + 2 = 7. & 6 - 4 + 2 = 4. \\
 9 - 2 + 1 = 8. & 8 - 6 + 5 = 7. & 6 - 1 + 5 = 10. \\
 9 - 4 + 5 = 10. & 7 - 4 + 3 = 6. & 6 - 3 + 2 = 5. \\
 7 - 6 + 8 = 9. & 7 - 5 + 8 = 10. & 5 - 4 + 6 = 7. \\
 8 - 2 + 4 = 10. & 7 - 1 + 3 = 9. & 5 - 2 + 3 = 6.
 \end{array}$$

Writing: Similar tasks.

EXERCISE 40.

$$\begin{array}{llll}
 2 \times 2 = 4. & 5 \times 2 = 10. & 3 \times 3 = 9. & 7 \times 1 = 7. \\
 3 \times 2 = 6. & 2 \times 5 = 10. & 1 \times 5 = 5. & 3 \times 1 = 3. \\
 4 \times 2 = 8. & 2 \times 3 = 6. & 1 \times 7 = 7. & 8 \times 1 = 8.
 \end{array}$$

Writing : Similar tasks.

EXERCISE 41.

$$\begin{array}{llll}
 2 \times 3 + 4 = 10. & 3 \times 2 + 3 = 9. & 4 \times 2 + 1 = 9. \\
 2 \times 2 + 1 = 5. & 5 \times 1 + 4 = 9. & 4 \times 1 + 4 = 8. \\
 2 \times 4 + 2 = 10. & 7 \times 1 + 3 = 10. & 2 \times 2 + 3 = 7. \\
 1 \times 2 + 5 = 7. & 3 \times 3 + 1 = 10. & 3 \times 2 + 4 = 10. \\
 4 \times 2 + 1 = 9. & 2 \times 2 + 5 = 9. & 3 \times 1 + 2 = 5.
 \end{array}$$

Writing : Similar tasks.

EXERCISE 42.

$$\begin{array}{llll}
 2 \times 2 - 1 = 3. & 3 \times 3 - 8 = 1. & 9 \times 1 - 5 = 4. \\
 5 \times 2 - 7 = 3. & 2 \times 5 - 6 = 4. & 1 \times 8 - 4 = 4. \\
 4 \times 2 - 6 = 2. & 2 \times 4 - 3 = 5. & 7 \times 1 - 5 = 2. \\
 3 \times 2 - 6 = 0. & 2 \times 3 - 1 = 5. & 6 \times 1 - 4 = 2. \\
 2 \times 3 - 4 = 2. & 7 \times 1 - 3 = 4. & 3 \times 3 - 5 = 4.
 \end{array}$$

Writing : Similar tasks.

EXERCISE 43.

Division. The teacher takes out of the brickbox a Four composed of two Twos, lays it on the desk, calls two children to him and says : " This 4 is to be divided between you. Whereabouts shall I cut it in two ? " The children point to the middle. The teacher makes believe to cut the Four in two at that place and gives each of the children a Two. The children say, first one by one, then in chorus : " Four divided into two pieces is a Two each piece."—In the same way : $2 : 2 = 1$. [I adopt the German abbreviation : instead of \div] $6 : 2 = 3$. $8 : 2 = 4$. $10 : 2 = 5$.

The division must however be *actually performed (before their eyes)* several times.

Writing : The children draw a 2, a 4, a 6, an 8 and a 10, and by a stroke cut each into two equal pieces. The corresponding figures can be written, as well, in the pieces.

EXERCISE 44.

Division into three parts, first actually and visibly done as above, then orally :

" Three divided into three pieces is each piece a One."

" Six divided into three pieces is each piece a Two " &c.

Writing : 3, 6, 9 drawn and divided into three pieces.

EXERCISE 45.

Division into four or more pieces.

The children learn the abbreviation :

" Eight divided by four is two."

" Four divided by four is one."

" Nine divided by three is three."

" Nine divided by nine is one."

Writing : Two points \div mean "divided by."

So,

$$4 : 2 = 2. \quad 10 : 2 = 5. \quad 9 : 3 = 3. \quad 10 : 5 = 2.$$

$$2 : 2 = 1. \quad 8 : 2 = 4. \quad 6 : 3 = 2. \quad 10 : 10 = 1.$$

$$6 : 2 = 3. \quad 3 : 3 = 1. \quad 8 : 4 = 2. \quad 7 : 7 = 1.$$

Such tasks are written, and then read aloud.

EXERCISE 46.

$$4 : 2 + 5 = 7. \quad 8 : 2 + 3 = 7. \quad 9 : 3 + 5 = 8.$$

$$8 : 2 + 6 = 10. \quad 10 : 2 + 1 = 6. \quad 10 : 2 + 3 = 8.$$

$$10 : 2 + 2 = 7. \quad 4 : 2 + 7 = 9. \quad 10 : 10 + 1 = 2.$$

$$6 : 2 + 4 = 7. \quad 6 : 2 + 5 = 8. \quad 9 : 3 + 2 = 5.$$

$$2 : 2 + 8 = 9. \quad 8 : 4 + 6 = 8. \quad 8 : 4 + 2 = 4.$$

Writing : Similar tasks.

EXERCISE 47.

$$\begin{array}{lll}
 2 + 4 : 2 = 3. & 7 + 1 : 4 = 2. & 4 + 3 : 7 = 1. \\
 4 + 6 : 5 = 2. & 3 + 7 : 2 = 5. & 2 + 2 : 4 = 1. \\
 3 + 1 : 2 = 2. & 4 + 2 : 3 = 2. & 1 + 9 : 5 = 2. \\
 5 + 4 : 3 = 3. & 1 + 4 : 5 = 1. & 3 + 6 : 9 = 1.
 \end{array}$$

Writing : Similar tasks.

EXERCISE 48.

$$\begin{array}{lll}
 4 : 2 - 1 = 1. & 2 : 2 - 1 = 0. & 10 : 2 - 1 = 4. \\
 8 : 2 - 3 = 1. & 9 : 3 - 1 = 2. & 10 : 2 - 2 = 3. \\
 10 : 2 - 3 = 2. & 6 : 2 - 2 = 1. & 9 : 3 - 3 = 0.
 \end{array}$$

Writing : Similar tasks.

EXERCISE 49.

$$\begin{array}{ll}
 9 - 1 : 2 = 4. & 10 - 1 : 3 = 3. \\
 10 - 4 : 3 = 2. & 10 - 2 : 4 = 2. \\
 8 - 6 : 2 = 1. & 9 - 5 : 4 = 1. \\
 7 - 1 : 2 = 3. & 9 - 2 : 7 = 1.
 \end{array}$$

Writing : Similar tasks.

EXERCISE 50.

$$\begin{array}{lll}
 4 : 2 \times 3 = 6. & 6 : 2 \times 3 = 9. & 10 \times 1 : 5 = 2. \\
 5 : 5 \times 7 = 7. & 10 : 5 \times 4 = 8. & 3 \times 3 : 9 = 1. \\
 9 : 3 \times 2 = 6. & 4 \times 2 : 8 = 1. & 4 \times 2 : 2 = 4. \\
 8 : 4 \times 5 = 10. & 3 \times 2 : 3 = 2. & 6 \times 1 : 2 = 3.
 \end{array}$$

Writing : Similar tasks.

EXERCISE 51.

$$\begin{array}{ll}
 1 + 2 \times 2 : 3 + 4 = 6. & 2 + 2 \times 2 : 4 - 1 = 1. \\
 2 + 3 - 1 \times 2 : 8 = 1. & 1 + 1 \times 3 - 4 : 2 = 1. \\
 4 + 5 - 3 : 2 \times 3 = 9. & 5 + 4 - 1 : 4 + 7 = 9. \\
 2 + 5 - 4 \times 2 : 2 = 3. & 3 + 7 - 1 : 3 + 7 = 10.
 \end{array}$$

Writing : Similar tasks.

EXERCISE 52.

$$\begin{array}{l}
8 : 2 + 1 - 3 \times 4 + 1 : 3 \times 1 = 3. \\
6 : 3 + 4 + 4 - 1 : 3 : 3 + 1 = 2. \\
10 : 5 - 1 \times 8 : 2 + 2 : 3 \times 5 = 10. \\
9 : 3 + 5 : 4 \times 3 : 6 + 7 : 2 = 4. \\
8 : 2 : 2 \times 5 - 7 \times 3 + 1 - 4 = 6. \\
6 : 6 \times 4 : 2 + 5 - 3 : 2 + 7 = 9. \\
6 : 2 + 4 + 3 : 5 - 1 \times 4 : 2 = 2. \\
4 : 2 \times 5 - 9 + 6 : 7 + 4 \times 2 = 10. \\
4 : 4 + 5 : 3 + 7 - 3 : 3 \times 2 = 4. \\
9 : 3 + 7 - 5 \times 2 - 4 : 3 \times 3 - 1 = 5. \\
10 : 2 + 3 - 6 \times 3 - 4 : 2 \times 1 - 1 = 0.
\end{array}$$

Writing : Similar tasks.

The last two exercises I conduct in the following manner:—

I gave to each individual child, according to his capacity, an easy or a difficult one of these tasks, but always bit by bit, never naming the next operation till the child has given me a sign (by a nod) that he has finished the operation in hand. At the end of the task there needs only to say "How much?", and the final result is named. It is seldom wrong. These exercises never fail to cause a peculiarly keen and pleased attention on the part of the little folk, who, while this work is going on, eagerly check each other and so spur each other on. Accordingly, it is by no means unusual for them to calculate a sum of mine as fast as I, with scarcely perceptible pauses, give it out to them.

Time for the 6th Section : 40 half-hours.

CONCLUDING REMARKS.

The above fifty-two exercises are taken direct from school life and are calculated for a year of forty weeks at four half-hours a week. Should the description seem too minute,

too prolix here and there, I may remark that a certain minuteness was intended, since experience has repeatedly shown that a sketchy description of this course of instruction led to a wrong apprehension of it and to rejection of it. Young elementary teachers may with confidence take to and keep to the exercises and rest assured that, with diligence and patience, the most delightful results will be attained. For those children who find arithmetic particularly difficult one has only to employ the brickbox at home and have the exercises (especially 21—28) diligently gone through in the manner prescribed, under the supervision of elder sisters, and the children will be spared many a trouble, and the parents many an anxiety.

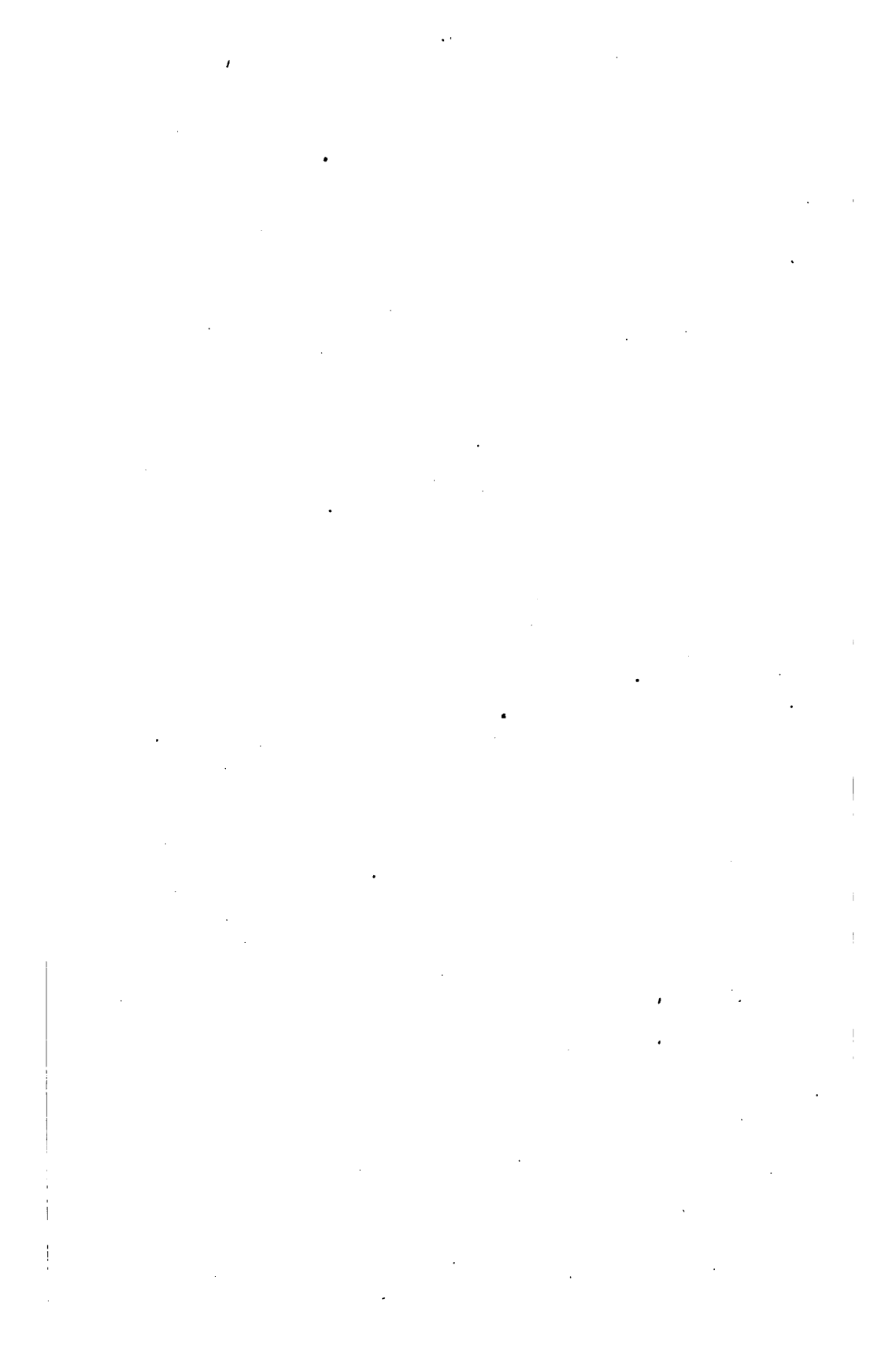


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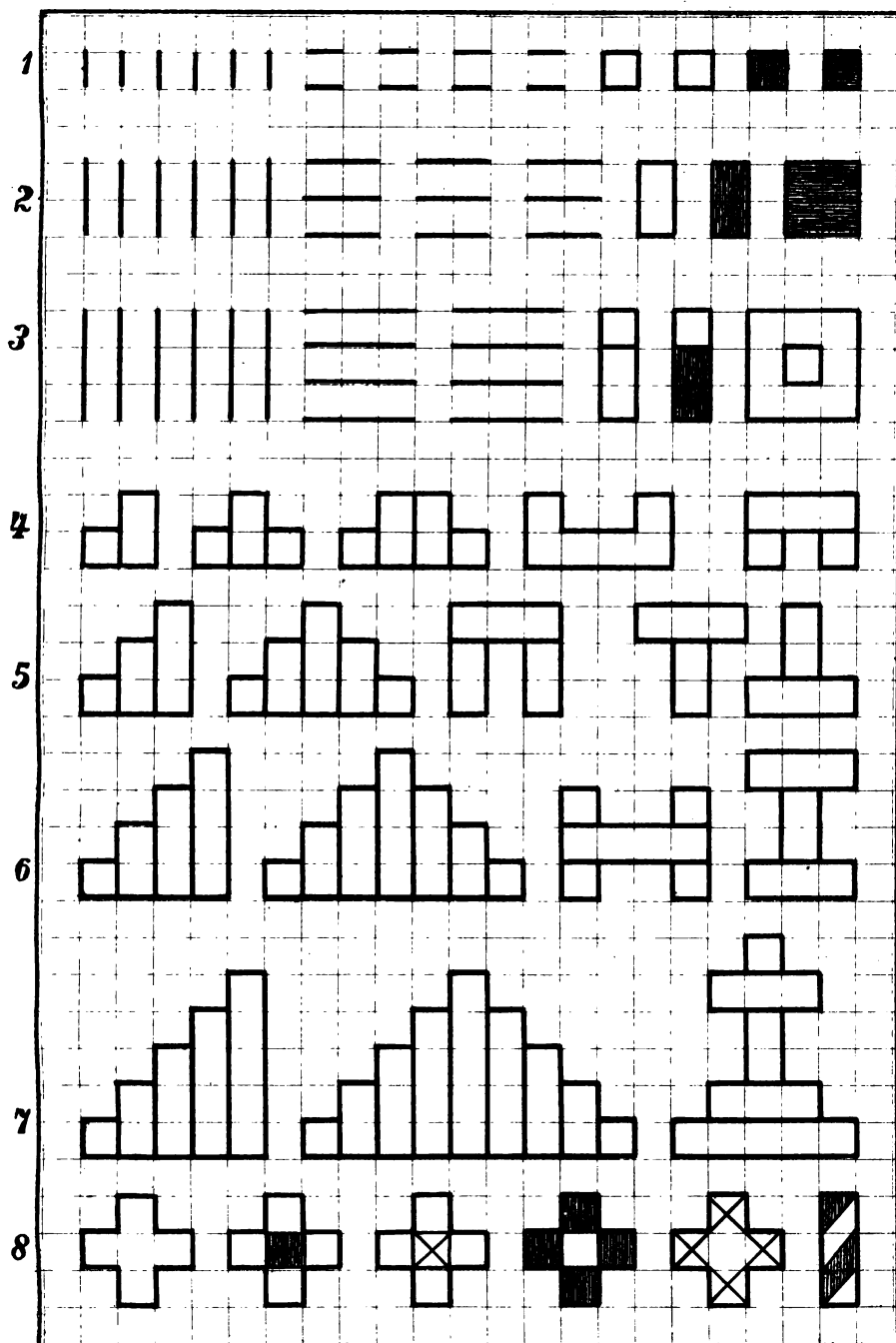


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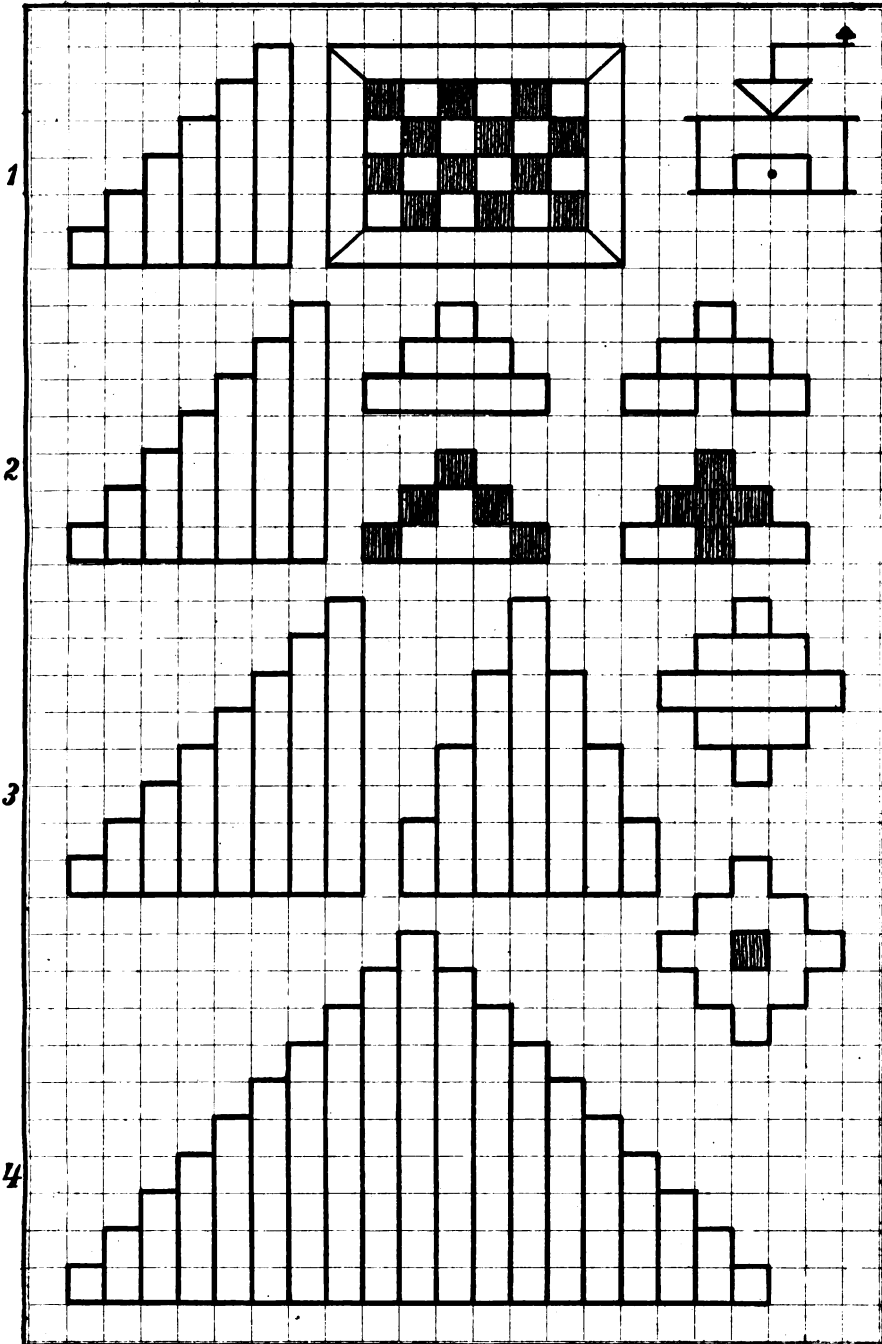
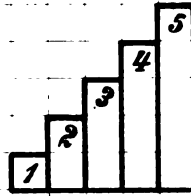
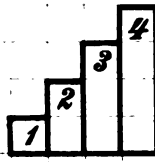
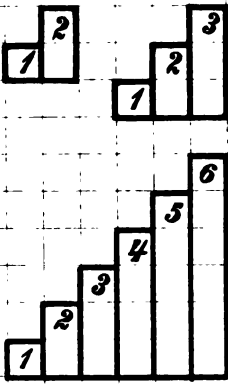
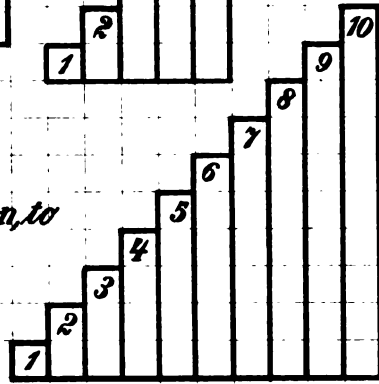


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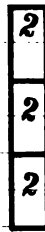
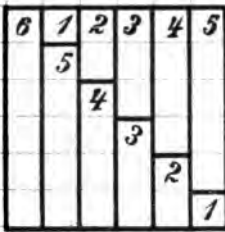
1



and so on, to



2a



2b

$$\begin{aligned} 6 &= 5 + 1 \\ 6 &= 4 + 2 \\ 6 &= 3 + 3 \\ 6 &= 2 + 4 \\ 6 &= 1 + 5 \end{aligned}$$

$$\begin{aligned} 6 &= 6 \times 1 \\ 6 &= 3 \times 2 \\ 6 &= 2 \times 3 \end{aligned}$$

$$\begin{aligned} 6 &= 4 + 1 + 1 \\ 6 &= 1 + 2 + 3 \\ 6 &= 1 + 2 + 2 + 1 \\ 6 &= 2 + 2 + 1 + 1 \end{aligned}$$

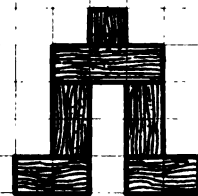
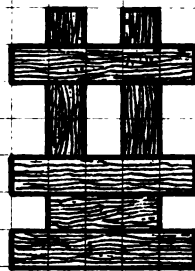
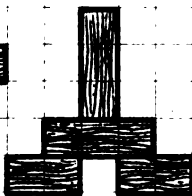


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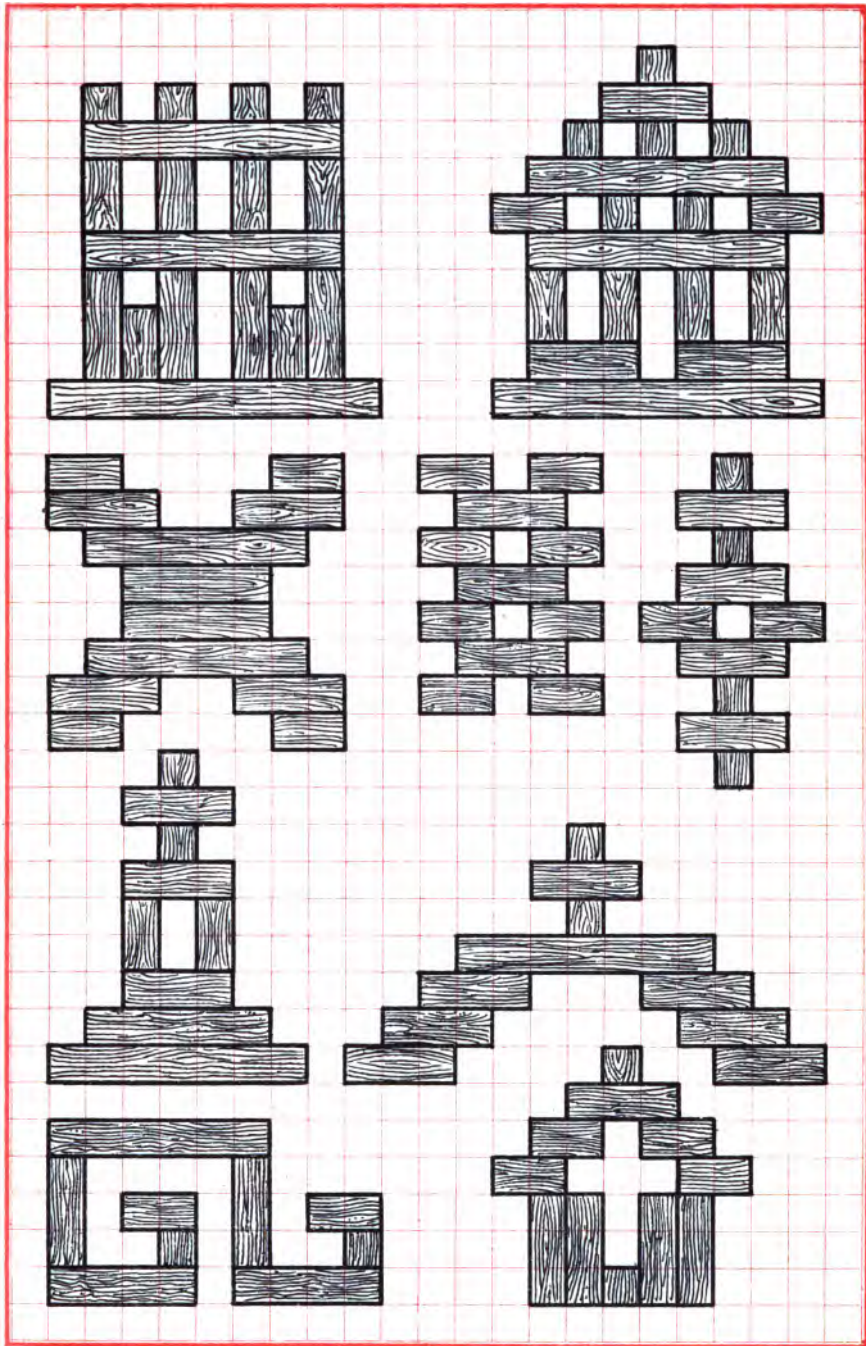
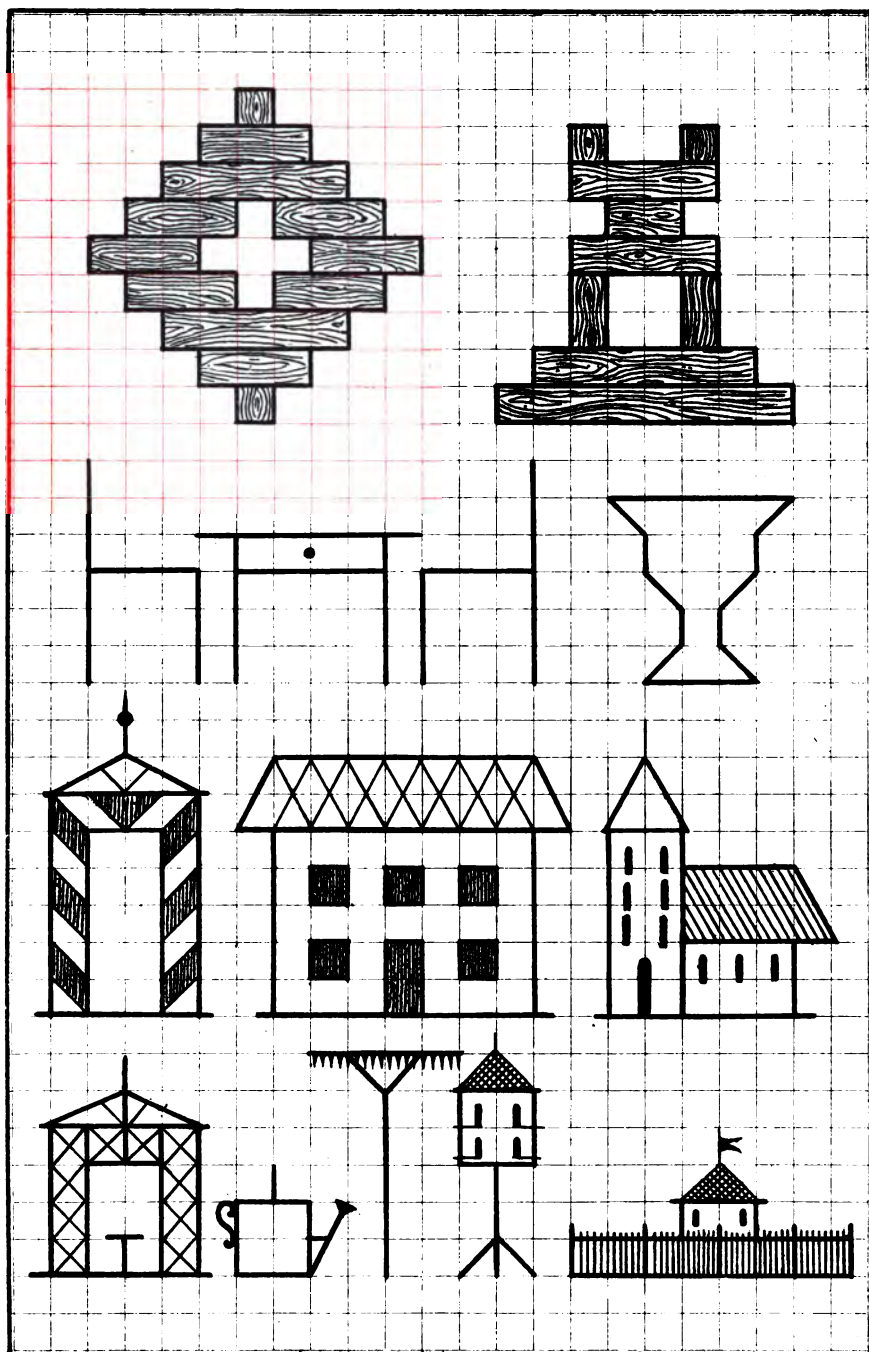


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